CLASS 9 SCIENCE

CHAPTER 6 • HOW FORCES AFFECT MOTION

NUMERICAL PROBLEMS • Practice + Answers

Formula Sheet: F = ma | a = F/m | F = mg | a = (v – u)/t | v = u + at | s = ut + ½at² | For connected objects on a frictionless surface: a = F/(m■ + m■)

1. A 5 kg object is acted upon by a net force of 20 N. Calculate its acceleration.

Answer: Using F = ma, a = F/m = 20/5 = **4 m/s²**.

2. A net force of 45 N produces an acceleration of 3 m/s² in an object. Find its mass.

Answer: m = F/a = 45/3 = **15 kg**.

3. An object of mass 8 kg accelerates at 2.5 m/s². Calculate the net force acting on it.

Answer: F = ma = 8 × 2.5 = **20 N**.

4. A 12 kg box is pushed with a force of 60 N on a frictionless horizontal surface. Find its acceleration.

Answer: a = F/m = 60/12 = **5 m/s²**.

5. A 10 kg object is pulled with 80 N while friction opposes the motion with 20 N. Find the net force and acceleration.

Answer: Net force = 80 – 20 = **60 N**. Acceleration = 60/10 = **6 m/s²**.

6. A 25 kg block is pushed with 50 N. Friction opposing motion is also 50 N. Find the acceleration.

Answer: Net force = 50 – 50 = **0 N**. Therefore acceleration = **0 m/s²**; the forces are balanced.

7. A 25 kg block is pushed with 55 N while friction is 50 N. Find its acceleration.

Answer: Net force = 55 – 50 = 5 N. a = 5/25 = **0.2 m/s²**.

8. For the previous 25 kg block, initially at rest, calculate its displacement in 2 s if its acceleration is 0.2 m/s².

Answer: $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}(0.2)(2^2) =$ **0.4 m**.

9. A 30 kg barbell is held steady. Take g = 9.8 m/s². Calculate its weight.

Answer: F = mg = 30 × 9.8 = **294 N** downward.

10. What upward force must be applied to keep the 30 kg barbell steady?

Answer: For equilibrium, the upward force equals its weight: **294 N upward**.

11. A 1500 kg car changes velocity from 0 m/s to 10 m/s in 5 s. Calculate its acceleration and net force.

Answer: a = (v–u)/t = 10/5 = **2 m/s²**. F = 1500×2 = **3000 N**.

12. A 1500 kg car slows from 10 m/s to 0 m/s in 5 s. Calculate its acceleration and force.

Answer: a = (0–10)/5 = –**2 m/s²**. F = 1500(–2) = –**3000 N**, opposite to motion.

13. A 100 g toy car moves at constant velocity of 0.5 m/s. What is the net force acting on it?

Answer: Constant velocity means acceleration = 0. Therefore F = ma = **0 N**.

14. A 6 kg object experiences a net force of 18 N. If the force is doubled while mass remains unchanged, find its new acceleration.

Answer: Original a = 18/6 = 3 m/s². New force = 36 N, so new a = 36/6 = **6 m/s²**.

15. A 4 kg object has an acceleration of 3 m/s². If the same net force acts on an 8 kg object, find its acceleration.

Answer: Force = 4×3 = 12 N. New acceleration = 12/8 = **1.5 m/s²**.

16. Two boxes of masses 4 kg and 6 kg are connected by a string on a frictionless horizontal surface. A 30 N external force pulls the system. Find the acceleration.

Answer: Total mass = 4+6 = 10 kg. a = F/(m■+m■) = 30/10 = **3 m/s²**.

17. Two boxes of masses 5 kg and 10 kg are connected and pulled by a 45 N force on a frictionless surface. Find the acceleration.

Answer: Total mass = 15 kg. a = 45/15 = **3 m/s²**.

18. A 2 kg object moving at 4 m/s is brought to rest in 2 s. Calculate its acceleration and net force.

Answer: a = (0–4)/2 = –**2 m/s²**. F = 2(–2) = –**4 N**.

19. A 3 kg object initially at rest is acted upon by a net force of 12 N for 5 s. Find its acceleration and final velocity.

Answer: a = 12/3 = **4 m/s²**. v = u+at = 0+4×5 = **20 m/s**.

20. A 10 kg object starts from rest and accelerates at 2 m/s² for 5 s. Calculate its final velocity and displacement.

Answer: v = 0+2×5 = **10 m/s**. s = ½(2)(5²) = **25 m**.

21. A force of 40 N acts on a 5 kg object for 4 s from rest. Find its acceleration, final velocity and displacement.

Answer: $a = 40/5 =$ **8 m/s²**; $v = 8\times4 =$ **32 m/s**; $s = \frac{1}{2}\times8\times4^2 =$ **64 m**.

22. A 20 kg box is pulled by 100 N and experiences 40 N friction. If it starts from rest, find its acceleration and velocity after 3 s.

Answer: Net force = 60 N. $a = 60/20 =$ **3 m/s²**. $v = 0+3\times3 =$ **9 m/s**.

23. A 50 kg object is moving at 6 m/s. A net force of 100 N acts opposite to its motion. Find its acceleration and time required to stop.

Answer: $a = -100/50 =$ **–2 m/s²**. Using $0 = 6-2t$, $t =$ **3 s**.

24. Two opposite forces of 150 N and 90 N act on a 12 kg object. Find the net force and acceleration.

Answer: Net force = 150–90 = **60 N**. $a = 60/12 =$ **5 m/s²** toward the 150 N force.

25. In a snake boat race, 95 oarsmen each apply 200 N backward while 5 oarsmen each apply 200 N in the opposite direction. Find the net force on the boat.

Answer: Forward force = 95×200 = 19000 N. Opposing force = 5×200 = 1000 N. Net force = **18000 N forward**.

ANSWER CHECKLIST

Chapter 6 • How Forces Affect Motion

Problem	Final Answer	Problem	Final Answer
1	Using F = ma, a = F/m = 20/5 = 4 m/s².	13	Constant velocity means acceleration = 0. Therefore F
2	m = F/a = 45/3 = 15 kg.	14	Original a = 18/6 = 3 m/s². New force = 36 N, so new a =
3	F = ma = 8 × 2.5 = 20 N.	15	Force = 4×3 = 12 N. New acceleration = 12/8 = 1.5 m/s².
4	a = F/m = 60/12 = 5 m/s².	16	Total mass = 4+6 = 10 kg. a = F/(m■+m■) = 30/10 = 3 m
5	Net force = 80 – 20 = 60 N. Acceleration = 60/10 = 6 m/s².	17	Total mass = 15 kg. a = 45/15 = 3 m/s².
6	Net force = 50 – 50 = 0 N. Therefore acceleration = 0 m/s²; the forces are balanced.	18	a = (0–4)/2 = –2 m/s². F = 2(–2) = –4 N.
7	Net force = 55 – 50 = 5 N. a = 5/25 = 0.2 m/s².	19	a = 12/3 = 4 m/s². v = u+at = 0+4×5 = 20 m/s.
8	s = ut + ½at² = 0 + ½(0.2)(2²) = 0.4 m.	20	v = 0+2×5 = 10 m/s. s = ½(2)(5²) = 25 m.
9	F = mg = 30 × 9.8 = 294 N downward.	21	a = 40/5 = 8 m/s²; v = 8×4 = 32 m/s; s = ½×8×4² = 64 m.
10	For equilibrium, the upward force equals its weight: 294 N upward.	22	Net force = 60 N. a = 60/20 = 3 m/s². v = 0+3×3 = 9 m/s.
11	a = (v–u)/t = 10/5 = 2 m/s². F = 1500×2 = 3000 N.	23	a = –100/50 = –2 m/s². Using 0 = 6–2t, t = 3 s.
12	a = (0–10)/5 = –2 m/s². F = 1500(–2) = –3000 N, opposite to motion.	24	Net force = 150–90 = 60 N. a = 60/12 = 5 m/s² toward the
25	Forward force = 95×200 = 19000 N. Opposing force = 5×200 = 1000 N. Net force = 18000 N forward.		

Source alignment: Chapter 6 covers Newton's laws, force, mass and acceleration, friction, weight, kinematics and systems of connected objects. The textbook examples include a 30 kg barbell (294 N), a 25 kg block with friction (0.2 m/s² and 0.4 m displacement), a 1500 kg sports car, and the connected-box system formula. ■filecite■turn217file4■L261-L288■ ■filecite■turn217file7■L425-L460■ ■filecite■turn216file3■L219-L258■